pattern should be straight to allow of adduction of the big toe, but ordinarily, unless there is marked hallux valgus calling for treatment (the wearing of a toe-post, etc.) it is customary to allow the toe of the shoe to conform more to the regulation shape, since it has been found that the toe will rarely move in to fill the vacant place that would be left were the edge made straight (Fig. 12).

The services of a shoemaker are now called in and measurements of the foot are taken as follows: (1) Circumference of the foot over the big and the little toes; (2) the ball of the foot; (3) the waist; (4) the instep; (5) the heel and the top of the instep, and (6) the heel (Fig. 13). Measurements are also taken for the ankle and the top of the shoe. These measurements and the inner sole patterns are now sent to the lastmaker.

The lastmaker has a model last in stock and he makes for the patient a last similar to the model last, but having an inner sole pattern and measurements corresponding to the patient's foot. The last is now returned to the shoemaker, who makes any little change that may be necessary to ensure a more perfectly fitting shoe, and the shoe is made. It will, of course, be understood that separate inner sole patterns, measurements, and lasts have to be made for both feet of the patient.

In conclusion, I would say that most excellent results have followed the use of a proper shoe such as has been described. There is almost always some difficulty on the part of the patient in becoming accustomed to the new shape; but in a few days the discomfort wears away and the freedom of motion and comfort consequent upon the use of properly constructed shoes soon cause him to become an earnest advocate of their use.

THE TREATMENT OF COMPRESSED-AIR (CAISSON) ILLNESS.

By Henry H. Pelton, A.M., M.D.,
CHIEF OF THE MEDICAL CLINIC, PRESBYTERIAN HOSPITAL DISPENSARY, NEW YORK; INSTRUCTOR IN MEDICINE, NEW YORK POST-GRADUATE MEDICAL SCHOOL.

While compressed-air illness, or caisson disease, is an affection which is seldom seen by the general practitioner, it is becoming of considerable interest on account of the growing necessity for increased transportation facilities and the consequent need for underground tunnels, bridges, and other structures which necessitate the sinking of caissons. The disease occurs as a result of work in compressed air at pressures greater than the normal fifteen pounds to the square inch, and is believed to be due to the presence of gas emboli in the circulation. A discussion of its causation, however, is beyond the scope of this paper.

Toward prophylaxis of the affection much can be accomplished by taking certain precautions. All applicants for work under pressure should be subjected to as rigid a physical examination as that considered necessary for an individual applying for life insurance. Preliminary to this examination the previous history of the candidate with regard to ophthalmic, nasal, aural, rheumatic, cardiac, pulmonary, hepatic, renal, and venereal conditions and cranial injuries should be ascertained. He should also be questioned as to whether or not he has ever worked in air under pressure, and, if the reply is in the affirmative, whether he has suffered from any of the symptoms of caisson disease. The subject should also be submitted to a thorough physical examination, and his urine should be tested for albumin and glucose.

The conclusions may be drawn that the laborer in compressed air should not be younger than twenty nor older than thirty-five years, that his muscular system should be, at least, normally developed, that his eyes and ears should be normal, and that his general physical condition should be in no way vitiated. It is usually the part of wisdom to disqualify, at least temporarily, subjects whose pulse is too rapid (above 100) or irregular, as well as those who give evidence of cardiac, arterial, pulmonary, hepatic, or renal disease. Alcoholism, unless the applicant exhibits the signs of this condition in its acute stage, is not a reason for disqualification, else it would be most difficult to obtain workers. Observation seems to show that the negro and the Anglo-Saxon races are less subject to the evil effects of air under pressure than are Italians, Poles, and other Eastern Europeans.

In considering the examination of candidates for employment a word should be said concerning status lymphaticus. It has been held by pathologists, who have made autopsies upon subjects dead of compressed-air illness, that status lymphaticus is often present, and consequently the signs of this condition should be sought as a part of the routine physical examination. Status lymphaticus is an obscure condition and one most difficult of diagnosis, but the following points are useful in its recognition: The lymphoid tissues should be examined for evidence of hypertophy. This examination should include a consideration of the superficial lymph glands (which often are but little enlarged) and an inspection of the throat for hypertrophied tonsils, lingual and pharyngeal tonsils, and adenoid growths. Splenic and thymic enlargements should be sought, and the heart and bloodvessels should be examined for hypoplasia, as evidenced by small size and thinness of the walls of the accessible arteries. According to Conner[1] the condition of the heart in status lymphaticus is variable; the organ may be hypoplastic or the left ventricle may be hypertrophied or dilated; in hypertrophy the pulse is small and of high tension. The body should be inspected for signs of infantilism, in which condition the beard and the axillary and pubic hair are scanty; the limbs, instead of being muscular and of masculine type, are rounded and resemble those of the female, and the figure, with regard to narrowness of the shoulders and breadth of the pelvis, may be more or less characteristically feminine. The height need not be below the normal; in fact, gigantism is sometimes present. Evidences of rickets and of thyroid enlargement should also be sought.

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[1] New York State Journal of Medicine, July, 1906.

After having passed a satisfactory examination the candidate should be subjected to a preliminary test, that is to say, he should be put under a pressure of from twenty-five to thirty pounds for an hour and a half; following this he should undergo a second physical examination, and should there be no reason for his disqualification, he may be allowed to undertake work in the compressed air, after having received certain warnings and advice, as follows: The air chamber should not be entered unless the subject feels perfectly well, and it is unwise to begin work on an empty stomach. Intoxicants should be used sparingly, or, better, not at all; but little water should be drunk while under pressure, and the laborer should obtain at least seven hours' sleep per day. As the pressure is raised the fulness in the ears, which is caused by the difference in the pressure outside the membrana tympani and that within this structure, may be relieved by swallowing or by closing the mouth, holding the nostrils, and performing the act of blowing the nose. This forces the Eustachian tubes open and thus equalizes the pressure. Emergence from the compressed air must be slow; at least fifteen minutes (and still better, thirty) should be taken to come out from a pressure of thirty pounds, the pressure being allowed to fall not faster than two pounds per minute. The laborers should come out of the pressure as follows: at the end of the shift they enter the air lock, the pressure in which is equal to that in the caisson where they have been working. The door between the caisson and the air lock should be closed and the exit valve of the latter opened sufficiently to allow a slow and gradual outflow of the compressed air. When this has escaped and the pressure within the lock has become equal to that outside the laborers should be liberated. After coming out hot coffee should be drunk freely, and warm, dry woollen clothing should be put on. All exposure to cold should be avoided and no undue exercise should be undertaken for at least an hour after emergence. Beer or other cold liquids should not be drunk for a considerable period after leaving pressure.

If the caisson is underground elevators should be provided to bring the laborers to the surface, for the climbing of ladders seems to predispose in marked degree to the occurrence of the evil effects of working in compressed air.

Individuals suffering from compressed-air illness usually exhibit the affection in one of four main types:

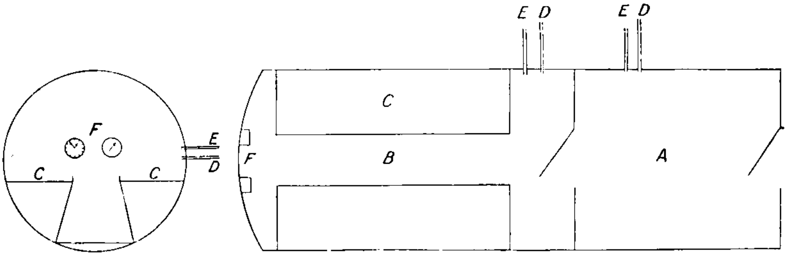
1. "*The Bends.*" This is the mildest form of caisson disease and is characterized by pains of varying severity. These are most common in the limbs; one limb or all may be affected, but the legs suffer more commonly than do the arms. The pains may be extremely severe; they are continuous, as a rule, but paroxysmal exacerbations may be observed. The pain is increased on motion, but there is no swelling, and tenderness is sometimes not notable. Itching of the skin is a frequent symptom. Abdominal cramps are not uncommon, and a condition termed "*the chokes*" is occasionally seen. This is characterized by cough, a sense of oppression of the chest, and some difficulty in respiration. The symptoms described, like all the manifestations of compressed-air illness, usually appear within an hour after emergence from the compressed air. Under treatment the pains disappear, as a rule, but they may be persistent, and sometimes reappear after apparent recovery.

2. "*The Staggers.*" This type of compressed-air illness is characterized by dizziness and staggering. At times the latter may be so marked that the patient falls, usually to one side or the other, unless he is supported. Vomiting may be present and the pulse may be rapid and weak. Spots may appear upon the skin of the abdomen, back, and limbs; these are purplish in color, and vary in size from that of a finger-nail to that of a quarter-dollar. There may be dimness of vision and nystagmus. The condition of the pupil is variable. The hearing is often diminished in acuity, but the patient will usually answer rationally upon loud questioning. There is seldom any mental disturbance. Pains in the limbs or abdomen may be present, and numbness of the extremities may be noted.

3. *The Paralytic Type.* The motor and other symptoms of this type of the affection are in no way characteristic. The loss of motility may be gradual or sudden, and there may be monoplegia, hemiplegia, or paraplegia; the last is, perhaps, most common. Sensation may be delayed or absent, or there may be irregular areas of anesthesia which sometimes occur without paralysis. The reflexes may be normal, lost, or exaggerated, and a spastic condition of the limbs has been noted. There frequently is retention of urine necessitating catheterization; more rarely there is paralysis of the bladder and the rectum, with incontinence. The mind, as a rule, remains clear. The paralyses may disappear permanently upon treatment; they may be temporarily relieved, to occur again, or they may resist all efforts. As a rule, however, they are not permanent, although months may elapse before entire recovery takes place.

4. *The Comatose Type.* In this type the most prominent symptom is partial or complete coma, which may appear suddenly after emergence from the pressure or may be preceded by other manifesta-

tions of the affection, more particularly those described under the second form of the disease. In the semiconscious cases active delirium may be present. The coma of caisson disease is in no way characteristic. The patient may suddenly become unconscious and die within an hour, or less, of cardiac or respiratory failure, the pulse growing weaker and weaker and the respiration increasingly slower until the end ensues. Comatose patients usually exhibit cyanosis of the lips and face. The skin is moist with a cold perspiration; the pupils may be normal, dilated, contracted, or unequal; their reaction may be sluggish and nystagmus may be observed. The pulse is often weak, thready, and irregular, and the respiration stertorous. There may be frothing at the mouth, nose-bleed, vomiting, sometimes with blood, and the rectum and bladder may be incontinent. The limbs may be flaccid or rigid, or there may be convulsive movements. The reflexes are in no way typical. The temperature may be normal or elevated. A fatal outcome is the rule in almost all instances in which absolute coma is present.



Plan and section of hospital lock. *A*, entrance chamber; *B*, hospital chamber; *C*, cots; *D*, compressed air supply; *E*, compressed air exhaust; *F*, clock, gauge, thermometer, and telephone.

In making the foregoing classification I by no means wish to draw definite lines of distinction between the different types, since the symptoms of the various groups are often so interwoven as to make arbitrary division quite impossible.

It seems probable that the indefiniteness of the symptoms of compressed-air illness is due to the fact that the gas emboli may lodge in any part of the nervous system and by their presence cause the clinical manifestations which become apparent, these latter being referable to the portion of the nervous system which is involved.

TREATMENT. In the treatment of all types of compressed-air illness the first consideration is recompression of the patient, that is to say, he must be subjected to the further influence of compressed air. For this purpose so-called hospital locks should be provided. Such a lock may consist of a horizontal cylinder made of one-half to three-quarter inch boiler iron; a very practical size is about twenty-five feet in length by seven feet in diameter (see figure). The lock should be divided into two chambers by a partition in which is an air-tight door opening outward. The open end of the lock should be fitted with a similar door. The double-chambered lock is the most practical type, for since both chambers are supplied with outlet and inlet valves, a means is thus afforded whereby the patient can be visited by an attendant without reducing the pressure to which the former is being subjected. Adjuncts which increase the efficiency of the lock are a couch, upon which the patient may lie; a telephone, by means of which he may communicate with the attendants outside; a clock, electric lights, and heating apparatus; the latter should be in the form of electric radiators, for steam radiators may possibly burst, a consequence which might produce most unpleasant effects.

Usually when the patient, if suffering merely from the first type of the affection, and especially if he has applied for treatment soon after the onset of his symptoms, is subjected to recompression he experiences very striking relief, the pains disappearing entirely long before the height of pressure in which he has been accustomed to work has been reached. The pressure is allowed to rise, even after relief is evident, to a height equal to that in which the patient has been working, and then he is "decompressed," that is, the pressure is slowly lowered to normal at the rate of about one-half pound per minute. Even slower decompression may be advisable in severe cases. Valves are obtainable which so control the outlet of air that the time necessary for the outflow of a given amount is the same whether the pressure within the lock be high or low. It must not be forgotten that it is necessary to supply the lock with a certain amount of fresh air after the inlet valve has been closed, otherwise the patient would be in danger of suffocation.

In treating instances of compressed-air disease it is unwise to subject the patient to the maximum pressure for more than five or ten minutes. When relief is experienced from the pain of an ordinary attack of the " bends " the patient is directed to move about the lock and to exercise and rub the affected part with a counterirritant ointment. In most of the mild cases the patient leaves the lock wholly relieved, but if there is a return of the pain recompression is advisable, the pressure being allowed to ascend until the pains disappear, when slow decompression is instituted as before. A third or even a fourth recompression may be employed if necessary, but usually the relief experienced from these subsequent treatments is temporary and slight in character. It is wise, if there is still continuation of the pain after the patient has been sufficiently recompressed, to advise thorough rubbing of the painful part with a counterirritant ointment or liniment. The following are suggested: capsicum oleoresin 2 parts, oil of turpentine 5 parts, oil of rosemary 5 parts, camphor 5 parts, olive oil 5 parts, petrolatum sufficient to make 100 parts; or menthol 10 parts, methyl salicylate 5 parts, hydrated chloral 10 parts, lanolin to 100 parts. The faradic current, applied as strong as can be comfortably borne, and the high-frequency current and vibratory massage may prove beneficial; hot baths, hot-water bags, and the electrotherm are very helpful adjuncts. Ironing the painful part with a hot flat-iron, a flannel cloth being interposed between it and the skin, is also suggested.

The persistent pains may be relieved by analgesics, such as salipyrine 10 grains every two hours, acetanilide 5 grains every four hours, or acetphenetidin 10 grains every three hours. These drugs should be given with care, and, if there is any tendency to heart weakness, they should be combined with citrated caffeine. Codeine may also be prescribed. Rarely are the symptoms severe enough to warrant the employment of morphine. In the management of all forms of the condition other than that characterized by pain, little in the way of specific treatment aside from decompression can be done.

Much, however, can be accomplished in the more serious types by the employment of symptomatic measures: when cardiac or respiratory weakness is evident hypodermic stimulation with strychnine, adrenalin chloride, caffeine, etc., should be resorted to. Artificial respiration may be indicated, and stimulation, by means of enemas of hot coffee, is always advisable in comatose cases. All these measures may be applied by attendants while the patient is under pressure in the hospital lock. Sometimes the results attained, even in patients in coma, are surprisingly good. Oxygen may be administered if there is respiratory failure, but should not be given while the patient is under pressure.

The after-treatment consists in careful nursing, feeding with nourishing food, and the use of tonics. Patients affected with persistent paralysis should receive the routine treatment of the chronic stage of peripheral neuritis. If the patient is confined to bed the prophylaxis of bed-sores is an important consideration, and if catheterization is necessary it is needless to state that this procedure should be conducted with the most thorough asepsis. The paralyzed muscles will be benefited and the patient's general condition will be improved by the systematic employment of galvanic and faradic electricity, massage, passive movements, and appropriate hydrotherapeutic measures.